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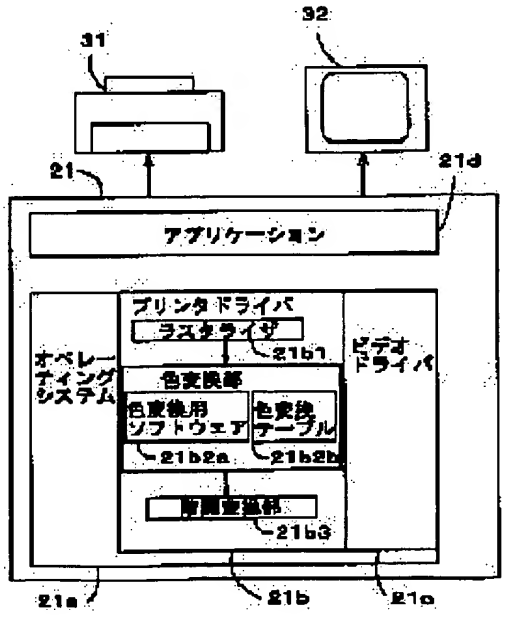
(54) APPARATUS AND METHOD FOR MANUFACTURING COLOR CONVERSION TABLE, AND RECORDING MEDIUM

(57)Abstract:
PROBLEM TO BE SOLVED: To generate a color conversion table optimum to the environment of the user or the like.
SOLUTION: When the installer is executed on a computer 2 being a component of an image processing unit, a color conversion table 21b2b is generated from an original color conversion table, number of grating points is increased by a nonlinear interpolation arithmetic operation or a linear interpolation arithmetic operation by utilizing the Lagrange's interpolation formula. In this case, number of the grating points may be fixed or number of grating points is selected in response to the environment or an input image and the color conversion table 21b2b with a proper size is generated from the original color conversion table with smaller size.



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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] The manufacturing installation of the color translation table which generates the color translation table which two or more lattice points were set [translation table] as the color specification space of a changing agency in order to change gradation color specification data between different color specification space characterized by providing the following, and made the gradation color specification data in the color specification space of a conversion place correspond to this lattice point The former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point A interpolation means to generate the color translation table which is made to increase the lattice point of this former color translation table according to a interpolation operation, and is used for conversion

[Claim 2] It is the manufacturing installation of the color translation table characterized by providing a nonlinear interpolation operation means to interpolate by the nonlinear interpolation operation from the correspondence relation of the lattice point of plurality [means / interpolation / above-mentioned] in the manufacturing installation of a color translation table given in the above-mentioned claim 1.

[Claim 3] It is the manufacturing installation of the color translation table characterized by the above-mentioned former color translation table being the above-mentioned claim 2 with the lattice point of an equal interval in the manufacturing installation of the color translation table of a publication.

[Claim 4] It is the manufacturing installation of the color translation table characterized by providing a linear interpolation operation means to interpolate by the linear interpolation operation from the correspondence relation of the lattice point of plurality [means / interpolation / above-mentioned] in the manufacturing installation of a color translation table given in the above-mentioned claim 1.

[Claim 5] It is the manufacturing installation of the color translation table characterized by making selectable the number of the lattice points which increase the above-mentioned interpolation means with interpolation in the manufacturing installation of a color translation table given in the above-mentioned claim 1 - a claim 4.

[Claim 6] It is the manufacturing installation of the color translation table characterized by setting up the number of the lattice points to which the above-mentioned interpolation means is increased in the manufacturing installation of the color translation table of a publication at the above-mentioned claim 5 according to environment.

[Claim 7] It is the manufacturing installation of the color translation table characterized by setting up the number of the lattice points to which the above-mentioned interpolation means is increased in the manufacturing installation of the color translation table of a publication at the above-mentioned claim 5 according to the kind of resolution picture.

[Claim 8] It is the manufacturing installation of the color translation table usually characterized by developing to the main storage area of the above-mentioned computer at the time of reference execution of a same color translation table while a computer refers the above-mentioned color translation table in the manufacturing installation of a color translation table given in the above-mentioned claim 1 and memorizing the above-mentioned former color translation table to the auxiliary memory of this computer at the time.

[Claim 9] In order to change gradation color specification data between different color specification space, two or more lattice points are set as the color specification space of a changing agency. It is the manufacture method of the color translation table which generates the color translation table which made the gradation color specification data in the color specification space of a conversion place correspond to this lattice point. The manufacture method of the color translation table characterized by generating the color translation table which is made to increase the aforementioned lattice point of the former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point according to a interpolation operation, and is used for conversion.

[Claim 10] In order to change gradation color specification data between different color specification space, two or more lattice points are set as the color specification space of a changing agency. It is the record medium which recorded the color translation table creation program which generates the color translation table which made the gradation color specification data in the color specification space of a conversion place correspond to this lattice point by computer. The record medium characterized by generating the color translation table which is made to increase the aforementioned lattice point of the former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point according to a interpolation operation, and is used for conversion.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the manufacturing installation, the manufacture method, and color inverter of a color translation table which generate the color translation table which made the gradation color specification data in the color specification space of a conversion place correspond to the lattice point in the color specification space of a changing agency, in order to change gradation color specification data between different color specification space.
[0002]
[Description of the Prior Art] Conventionally, the color printing system which carries out color printing of the color picture on a computer is known as this kind of a color translation table.
[0003] Although a gradation indication of the color picture is given by the three primary colors (R, G, B) of red-green blue about every pixel put in order in all directions inside the computer, it is printed in the state where there is no gradation display by four (C, M, Y, K) colors which added black to three colors (C, M, Y) of cyanogen, MAZENDA, and yellow or this in the general color printer. Therefore, in order to carry out color printing, the work of the color conversion to the display of three colors (C, M, Y) of cyanogen, MAZENDA, and yellow and the work of the gray scale conversion to the display without gradation from a gradation display are needed from the display of red-green blue in three primary colors (R, G, B). In addition, although it is one space, since a display cannot but change with how to take a coordinate, the color space itself will call it the color specification space according to how to take a coordinate for convenience below.
[0004] By the transformation, the color conversion to the display from this (R, G, B) display (C, M, Y) does not become settled uniquely, asks for the correspondence relation mutually about the color space which makes each gradation a coordinate, and, usually changes it from this correspondence relation serially. In here, at least, about each color, if the display (R, G, B) of a changing agency was 256 gradation, it must have the color translation table of about 16,700,000 elements (256x256x256).
[0005] The correspondence relation about all coordinate values is not prepared, but the correspondence relation is prepared about the suitable discontinuous lattice point, and it is made to use a interpolation operation together, as a result of considering use of efficient storage resources. That is, when asking for the correspondence relation of color specification space about the color (C, M, Y) of the existing coordinate in the inside of color specification (R, G, B) space, the correspondence relation of the lattice point which encloses this coordinate is used, and it is asking for the correspondence relation of this coordinate through operations, such as linear interpolation.
[0006] Generally the printer driver is equipped with such a color translation table, and only one is offered corresponding to the color printer of each [printer driver / itself / including the color translation table]. Therefore, it was specified as the number of the lattice points suitably defined from contrast with storage resources also about the color translation table.
[0007]
[Problem(s) to be Solved by the Invention] In the conventional color translation table mentioned above, since the side which offers a printer driver was creating the color translation table based on contrast with common storage resources, depending on a user's environment, the technical problem that it was not necessarily the optimal occurred. That is, when saying that it is better to say that it is still large depending on a user's environment, and to consider as bigger size, it was.
[0008] Furthermore, since a difference arose also in printing quality with the size of a color translation table, the technical problem that the color translation table of a fixed size was not enough also occurred.
[0009] this invention was made in view of the above-mentioned technical problem, and aims at offer of the manufacturing installation of the color translation table which can generate the optimal color translation table for a user's environment etc., and the manufacture method.
[0010]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention concerning a claim 1 It is the manufacturing installation of the color translation table which generates the color translation table which made the gradation color specification data in the color specification space of a conversion place correspond to the lattice point in the color specification space of a changing agency in order to change gradation color specification data between different color specification space. It has considered as the composition possessing a interpolation means to generate the former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point, and the color translation table which is made to increase the lattice point of this former color translation table according to a interpolation operation, and is used for conversion.

[0011] In invention concerning the claim 1 constituted as mentioned above, the former color translation table which made the lattice point a small number exists from the first, and it has not deer needed storage resources only. And a interpolation means makes the lattice point of this former color translation table increase according to a interpolation operation, generates a color translation table, and uses this generated color translation table for color conversion.
[0012] The number of the lattice points in a former color translation table does not need to be a not necessarily very few numeric value relatively as compared with the color translation table generated that what is necessary is just few. Especially, if it is the lattice point of three dimensions, some of lattice points will change by the cube. That is, the size of a color translation table serves as one eighth of sizes only by making the lattice point into a half, and a big effect will be given to storage resources also with some differences.
[0013] About a interpolation operation means, it is possible to apply various kinds of operations, and invention concerning a claim 2 is considered as the composition possessing a nonlinear interpolation operation means to interpolate by the nonlinear interpolation operation from the correspondence relation of the lattice point of plurality [means / interpolation / above-mentioned], in the manufacturing installation of a color translation table according to claim 1 as the example.
[0014] In invention concerning the claim 2 constituted as mentioned above, the nonlinear interpolation operation means of a interpolation means interpolates the lattice point by the nonlinear interpolation operation from the correspondence relation of two or more lattice points.
[0015] By performing a nonlinear interpolation operation, the correspondence relation in the lattice point increased will be reproduced correctly. Therefore, even if it lessens the lattice point of a former color translation table, it becomes possible to obtain a result with very sufficient repeatability.
[0016] On the other hand, there is relation also in this interpolation operation about the interval of the lattice point of a former color translation table, and invention concerning a claim 3 is considered as the composition used as the lattice point of an interval with the above-mentioned equal former color translation table in the manufacturing installation of a color translation table according to claim 2 as the example.
[0017] Although a lattice point interval does not necessarily need to be equal in a nonlinear interpolation operation, supposing it is an unequal lattice spacing, the coefficient of operation expression will become complicated. And when you are going to make it increase the lattice point by the interpolation operation within the cube of three dimensions at least, and work which asks for the middle-lattice point from two or more lattice points for every shaft orientations is needed and the coefficient of operation expression becomes complicated in such a case, a interpolation operation becomes complicated and work is troublesome. On the other hand, in being an equal lattice point interval, some coefficients etc. become fixed and situations, such as becoming easy to apply loop processing, arise.
[0018] Of course, depending on other interpolation operations other than a nonlinear interpolation operation, the more equal one may be desirable, the more nearly unequal one may be desirable, and it can change suitably according to a interpolation operation.

[0019] Moreover, invention concerning a claim 4 is considered as the composition possessing a linear interpolation operation means to interpolate by the linear interpolation operation from the correspondence relation of the lattice point of plurality [means / interpolation / above-mentioned], in the manufacturing installation of a color translation table according to claim 1 as an example using operations other than a nonlinear interpolation operation.
[0020] In the case of linear interpolation, there is also a merit that the operation expression itself is not complicated, and there is a property in which the number of the lattice points required for an operation is two to shaft orientations. Therefore, when a correspondence relation makes the lattice point fine in the portion which changes a lot, an exact correspondence relation can be easily obtained now and it also becomes easy for a correspondence relation to make the lattice point coarse conversely in the portion which does not change so much.
[0021] The number of the lattice points to which a interpolation operation means makes it increase does not necessarily need to be fixed, and invention concerning a claim 5 is considered as the composition in which the above-mentioned interpolation means presupposed that it is selectable the number of the lattice points to which it is made to increase with interpolation as the example in the manufacturing installation of a color translation table according to claim 1 to 4.
[0022] The size of a color translation table may change with the number of the lattice points increased, and the lattice point may affect the conversion precision in color conversion depending on a interpolation operation. Therefore, that the number of the lattice points to which it is made to increase with interpolation is selectable enables it to consider as the number of the optimal lattice points to a user's environment.
[0023] In this case, invention concerning a claim 6 is considered as the composition which sets up the number of the lattice points to which the above-mentioned interpolation means is increased according to environment in the manufacturing installation of a color translation table according to claim 5.
[0024] The size of a color translation table changes with the number of the lattice points, and the hit ratio at the time of color conversion also changes. Furthermore, it also becomes making a interpolation operation easy depending on the position of the lattice point to which it is made to increase. Therefore, the optimal color conversion can be offered by making the lattice point increase synthetically according to environment. What is necessary is for what is necessary just to be made to make the lattice point, if there are many storage resources and it desires the color translation table of big size, then to make color conversion precision high as a plan which chooses the lattice point which increases according to environment, when color conversion precision is high, so that it is good and there is much lattice point, and just to make it the interval of the lattice point become with

a power of 2, if it seems that the multiplication and division in a power of 2 are easy at the time of a
[0025] Furthermore, invention concerning a claim 7 is considered as the composition which sets up the number of the lattice points to which the above-mentioned interpolation means is increased according to the kind of resolution picture in the manufacturing installation of a color translation table according to claim 5 in choosing the lattice point which increases similarly.
[0026] Depending on a picture, there are some some which color conversion precision may be so high that there is much lattice point as mentioned above, and require color conversion precision highly in such a case, and there are some some which are not needed so much. For this reason, if it seems that the information on an resolution picture requires color conversion precision highly, the lattice point will be made [many / as possible], and the lattice point will not be made / many / so] if it seems that color conversion precision is not required so much. While the significance of sexual desire news, such as a photograph, will judge it as a high thing and will make [many / as possible] the lattice point as a plan in this case, if the extension of a file is a bit map, when the kind of resolution picture can be known from an operating system etc., when the extension of a file points out draw data and a business graph, as for the significance of sexual desire news, it is effective to judge it as a low thing and not to increase the lattice point so much.
[0027] As other examples in the example of embodiment of the thought of invention, invention concerning a claim 9 In order to change gradation color specification data between different color specification space, two or more lattice points are set as the color specification space of a changing agency. It is the manufacture method of the color translation table which generates the color translation table which made the gradation color specification data in the color specification space of a conversion place correspond to this lattice point. It is characterized by generating the color translation table which is made to increase the aforementioned lattice point of the former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point according to a interpolation operation, and is used for conversion.
[0028] That is, there is no difference not only in the equipment which not necessarily has substance but in being effective as the method.
[0029] By the way, a color inverter equipped with such a color translation table contains not only this but various kinds of modes as thought of that it may be used in the state where may exist independently and it was included in a certain device, and invention. Therefore, it can change suitably that it is software or is hardware etc.
[0030] In changing the gradation color specification data of color specification space which is different to the color specification space corresponding to printing ink as the example, the former color translation table which memorizes the correspondence relation of conversion in a small number of lattice point is used, the lattice point can be made to be able to increase according to a interpolation operation, a color translation table can be generated, and it can also consider as the composition which carries out color conversion using this generated color translation table.
[0031] That is, although a color translation table will be referred to in order that a printer driver may change the gradation color specification data of different color specification space to the color specification space corresponding to printing ink, color conversion is carried out using the color translation table which interpolated from the former color translation table of a small number of lattice point, and increased the increase of the lattice point, and the lattice point on this occasion.
[0032] When becoming the software of a color inverter as an example of embodiment of the thought of invention, naturally it exists like a claim 10 on the record medium which recorded this software, and it must be said that it is used. of course, the record medium may be a magnetic-recording medium, may be a magneto-optic-recording medium, and can completely be considered the same way in any record media developed from now on Moreover, about duplicate stages, such as a primary replica and a secondary replica, it is equivalent without room to completely ask. In addition, when it is software, it is also possible to perform processing to which the lattice point which was mentioned above in installation work is made to increase, and it is indifferent from the side which changes to this invention being used or is offered functioning as software offer equipment, even when carrying out as the supply method using a communication line, and using this invention similarly.
[0033] Furthermore, a part is software, when the part is realized by hardware, there is nothing that is completely different in the thought of invention, and it may be made into the thing of a gestalt which memorizes the part on the record medium and is read suitably if needed. Furthermore, it cannot be overemphasized that it can apply also in this color facsimile machine and color copier that will carry out color translation table use.
[0034]
[Effect of the Invention] It can consider as the color translation table which became a size required while only minimum storage resources are needed in the state where color conversion is not carried out, when performing color conversion since this invention was what generates the color translation table which increased the lattice point from the former color translation table of small size as explained above, and the manufacturing installation of a color translation table with more high versatility can be offered. Of course, only when required, it develops, and when unnecessary, you may make it not develop and it can also leave still in the state in the state where it developed when the margin was in storage resources.
[0035] Moreover, according to invention concerning a claim 2, since it is made to make the lattice point increase by the nonlinear interpolation operation, the precision of the increased lattice point becomes high and a good color conversion result can be obtained. If it says conversely, even if this will lessen the lattice point more, it also becomes the effect that a good result can be obtained.
[0036] Furthermore, according to invention concerning a claim 3, by making the lattice point of a former color translation table into an equal interval, a nonlinear interpolation operation can be prevented from complicating and reduction in the operation time etc. can be aimed at.

[0037] Furthermore, according to invention concerning a claim 4, a interpolation operation can be simply performed using linear interpolation with few amounts of operations. Moreover, if it uses simple [of linear interpolation], though it is simple by making the lattice point dense in a big change portion, there is also a merit of being able to aim at improvement in precision.
[0038] Furthermore, since the number of the lattice points to which it is made to increase can be chosen according to invention concerning a claim 5, the color translation table which was more flexibly suitable for a user's environment can be generated, such as deciding the size of a color translation table according to a user's storage resources. Since this can also generate the color translation table of two or more sizes, it also becomes possible of it to choose suitably and to use if needed, again.
[0039] Furthermore, according to invention concerning a claim 6, since the lattice point of the number according to environment is chosen, a user becomes unnecessary to carry out a troublesome setup.
[0040] Furthermore, according to invention concerning a claim 7, since it is made to choose the increase in the lattice point according to an resolution picture, the fault of not enlarging a color translation table too much unnecessarily, or having not enlarged the inadequate color translation table etc. can be abolished.
[0041] Furthermore, according to invention concerning a claim 9, the manufacture method of the color translation table in which the thing with more high versatility to do for color translation table generation is possible can be offered the same with having mentioned above.
[0042] Furthermore, according to invention concerning a claim 19, the manufacture program of a color translation table in which the thing with more high versatility to do for color translation table generation is possible can be offered as a record medium recorded possible [reading] by computer etc. the same with having mentioned above.
[0043]
[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing.
[0044] Drawing 1 shows the image processing system concerning 1 operation gestalt of this invention by the block diagram, and drawing 2 shows the example of concrete hardware composition by the block diagram.
[0045] In this drawing, a picture input device 10 picturizes a color picture, and outputs gradation color specification data to an image processing system 20, this image processing system 20 performs a predetermined image processing, and outputs it to the picture output unit 30, and this picture output unit 30 displays the original color picture.
[0046] In here, as for the example of a picture input device 10, a scanner 11, a digital still camera 12, etc. correspond, the computer system which the example of an image processing system 20 becomes from a computer 21, a hard disk 22, etc. corresponds, and, as for the example of the picture output unit 30, a printer 31 and display 32 grade correspond. Moreover, the record medium of the CD-ROM24 grade from which the record medium which can record the program which makes a computer etc. carry out this invention is read into a computer by drive equipment 23 corresponds.
[0047] While the scanner 11 as a picture input device 10 shall output the gradation data of RGB (green, blue, red) as gradation color specification data If the printer 31 as a picture output unit 30 shall need the binary data of CMY (cyanogen, MAZENDA, yellow) as an input as gradation color specification data The concrete role of this computer 21 as an image processing system 20 is changing the gradation data of RGB into the binary data of CMY. Moreover, usually a scanner 11 will differ in a color property from a display 32 also as that into which a display 32 inputs the gradation data of RGB, and a computer 21 will perform processing which changes the gradation data of RGB into the gradation data of RGB. It can say that the same is almost said of a digital still camera 12.
[0048] The processing performed inside this computer 21 is shown in drawing 3 . As shown in drawing, within the computer 21, operating system 21a is working and printer driver 21b and video driver 21c corresponding to the printer 31 or the display 32 are incorporated. On the other hand, application 21d, execution of processing is controlled by operating system 21a, it cooperates with printer driver 21b or video driver 21c if needed, and predetermined processing is performed.
[0049] The data for printing generated by application 21d are inputted into printer driver 21b through operating system 21a, and the printer driver 21b concerned is changed into the image data of the format which a printer 31 requires. It corresponds to the processing which changes into the binary data of CMY the gradation data of RGB which this conversion mentioned above. In here, this printer driver 21b consists of a rasterizer 21b1 which starts the scanning zone of the print head in a printer 31 from the image data which application 21d generates per predetermined screen, color transducer 21b2 which change the gradation data of RGB into the gradation data of CMY with reference to a color translation table about each pixel of this scanning zone, and a gradation transducer 21b3 which carries out the gray scale conversion of the gradation data of CMY to binary data. In addition, about the display image data which application 21d generates, video driver 21c writes in the predetermined memory for screens, and it is made to display on a display 32 through hardware circuitry.
[0050] The color transducer 21b2 is also called color-correction module, and consists of software 21b2a for color conversion and color translation table 21b2b which perform data processing of color conversion. Color translation table 21b2b is a three-dimensions look-up table for making the gradation color specification data in the color specification space of a conversion place correspond to the lattice point in the color specification space of a changing agency, in order to change gradation color specification data between different color specification space, and reading CMY gradation data by making the RGB gradation data of three dimensions as more specifically shown in drawing 4 into a coordinate value. And software 21b2a for color conversion performs processing which reads CMY gradation data by making the RGB gradation data of each pixel into a coordinate value.
[0051] These printer driver 21b including this color transducer 21b2 is developed on a hard disk 22 by the install program shown in drawing 5 . This installer is constituted from Step S130 which generates color translation table 21b2b of predetermined size

from former color translation table 21b2c of small size by Step S110 which performs a device check, Step S120 which develops the software for drivers containing the above-mentioned software 21b2a for color conversion on a hard disk 22, and the predetermined interpolation operation.
[0052] That is, according to a interpolation operation, just Step S130 which generates color translation table 21b2b of predetermined size constitutes the manufacturing installation of the color translation table in this invention from former color translation table 21b2c of small size, and the procedure constitutes the manufacture method of a color translation table. What is necessary is just to generate color translation table 21b2b of predetermined size from former color translation table 21b2c of small size as the function in this operation gestalt, although embodied as an installer of printer driver 21b, noting that it mentions later about this concrete technique. Therefore, you may be the software which generates a color translation table independently, or it is also possible to constitute from hardware which consists of wire logic. Moreover, it is also possible to constitute so that it may mention later and software 21b2a for color conversion may generate color translation table 21b2b if needed.
[0053] Next, this interpolation data processing is explained in full detail.
[0054] First, the case where a nonlinear interpolation operation is adopted as an example of interpolation data processing is explained.
[0055] if n points (Xi, Yi) (i= 0, 1, --, n-1) are given -- Yi=P(Xi) (-- i= -- 0, 1, --, the n-primary polynomial [0056] that fills n-1)
[Equation 1]

$$P(X) = c_{n-1} \cdot X^{**(n-1)} + c_{n-2} \cdot X^{**(n-2)} + \cdots$$

[0057] ** -- it becomes settled uniquely However, suppose that no two Xi(s) are equal. The closed formula showing this polynomial [0058]
[Equation 2]

$$P(X) = \sum_{i=0}^{N-1} \left\{ Y_i \prod_{j \neq i} \left((X - X_j) / (X_i - X_j) \right) \right\}$$

[0059] It is ** Lagrange's (Lagrange) interpolation formula. In addition, what multiplied ((X-Xj) / (Xi-Xj)) about all j other than j=i is meant below about pi of the right-hand side. The coding list in which the concrete real whereabouts method of this interpolation operation was shown by C is shown in drawing 6 .
[0060] Now, if such a interpolation operation is used, it is possible to increase three new grid coordinates and to carry out between grid coordinates between each grid coordinate, for 4 minutes using former color translation table 21b2c of the small size which has only five grid coordinates in each shaft orientations in fact as shown in drawing 7 . The grid coordinate interval in this case shall be equivalent to "64" gradation, and shall give grid number "0" - "4" to each grid coordinate of former color translation table 21b2c. Moreover, by newly carrying out between grid coordinates for 4 minutes, by color translation table 21b2b, it becomes grid number "0" - "16", and a grid coordinate interval becomes "16" gradation. In addition, it is impossible to prepare the lattice point originally equally distributed in this way as "256" gradation, and a calculation top simplifies calculation [so that the grid number (+one actual gradation) called "0" - "256"] by making the last grid number (for example, 256) shift to the grid number (equivalent to 255) of the last of the range of actual gradation at the last of calculation.
[0061] If the storage format within the install program of former color translation table 21b2c is described for the outline, as shown in the upper case of drawing 8 , that the data of three colors of CMY should be corresponded by making each component of RGB into a coordinate value, respectively, the number of elements serves as an array of (5, 5, 5, 3), and it is written in by solid one from the head of a file. Therefore, in order to refer to the correspondence data of former color translation table 21b2c, the grid number pointers Pr, Pg, and Pb corresponding to each of R shaft, G shaft, and B shaft are set up. From the head of a file, by making (Prx5x5x3+Pgx5x3+Pbx3) into the offset address, "1" byte eye and MAZENDA (M) will read "2" byte eye, and cyanogen (C) will read [yellow (Y)] "3" byte eye.
[0062] Of course, arrangement of not passing to an example, for example, arranging by all coordinates about cyanogen, and arranging by all coordinates one by one about MAZENDA and yellow is sufficient as this storage format. Or where file compression is carried out, you may save. However, when written in by solid one as an array, it can read by pointer value, the address can be calculated so that it may mention later, and the regularity at the time of reading can be set up freely.
[0063] Since it is the thing for which the storage format of color translation table 21b2b is shown in the lower berth of drawing 8 and which carries out between each lattice point of former color translation table 21b2c for 4 minutes, and newly forms three grid coordinates as mentioned above, the number of elements serves as an array of (17, 17, 17, 3), and it is made to write in by solid one from the head of a file on the other hand. Therefore, if the same grid number pointers Pr, Pg, and Pb as previously are set up in order to refer to the correspondence data of this color translation table 21b2b From the head of a file, by making (Prx17x17x3+Pgx17x3+Pbx3) into the offset address, "1" byte eye and MAZENDA (M) will read "2" byte eye, and cyanogen (C) will read [yellow (Y)] "3" byte eye.
[0064] The processing which increases the lattice point of color translation table 21b2b is shown in the flow chart of drawing 9 . In this processing, doing the work to which lattice point data are made to transfer at Step S210, since the lattice point which is in agreement by former color translation table 21b2c and color translation table 21b2b exists as shown in drawing 8 , blank data are inserted between the lattice points and it develops as a form of a file on a hard disk 22. Then, loop processing which carried out the nest about the grid number of each shaft is performed to fill up correspondence data with Step S220 about all the lattice points of color translation table 21b2b. Since a grid number is "0" - "16", it sets "0" - "16" as a pointer about R shaft, G shaft, and B

shaft, and repeats processing. Most, within an inside loop, it judges whether it is in agreement with the lattice point to which the lattice point shown with the pointer of R shaft, G shaft, and B shaft shifted from former color translation table 21b2c, and if not in agreement, processing which computes the correspondence data of the lattice point by the interpolation operation is performed. However, since there are already correspondence data if in agreement, processing of a interpolation operation is skipped.

[0065] An example of processing of a interpolation operation is shown in drawing 10 - drawing 12 . First, before explaining a flow, the concept of the nonlinear operation illustrated in drawing 11 is explained.

[0066] When it is going to apply Lagrange's interpolation formula shown in several 2 based on the correspondence data of a four point, it is unknown whether the four lattice points are not necessarily passed also as performing the interpolation operation of P points (Rp, Gp, Bp) shown in drawing 11 . Therefore, the correspondence data of four points required for the operation of P points will be computed supposing the cube which becomes each shaft orientations from the four lattice points before and after locating P points by performing a interpolation operation in order for every shaft orientations within this cube. In here, the grid coordinate for every shaft is set up with {R1, R2, R3, R4}, {G1, G2, G3 and G4}, and {B1, B-2, B3 and B4}.

[0067] First, when a straight line parallel to G shaft orientations which pass P points (point of illustration **) is assumed, this straight line will penetrate four RB flat surfaces which will pass the grid coordinate of G shaft. O point shows each of this intersection in this drawing, and the coordinate is (Rp, G4, Bp), (Rp, G3, Bp), (Rp, G2, Bp), and (Rp, G1, Bp). Since the correspondence data of this intersection itself are unknown, they assume a straight line parallel to B shaft on RB flat surface which crosses each intersection. This straight line penetrates four RG flat surfaces which will pass the grid coordinate of B shaft. Paying attention to the point that the coordinate of G shaft is "G1" among four straight lines, - point shows each intersection in this drawing. The coordinate is (Rp, G1, B1), (Rp, G1, B-2), (Rp, G1, B3), and (Rp, G1, B4), and correspondence data are still unknown. However, assumption of a straight line parallel to R shaft which passes these intersections passes the lattice point shortly [all]. Namely, the straight line which passes an intersection (Rp, G1, B1) passes (R1, G1, B1), (R2, G1, B1), (R3, G1, B1), and (R4, G1, B1).

[0068] Four (R1, G1, B1), (R2, G1, B1), if this is made to go back conversely When the correspondence data of (R3, G1, B1), and (R4, G1, B1) to one - point can be obtained and the correspondence data of four - points are obtained similarly, the correspondence data of one O point can be obtained. If this is repeated, the correspondence data of four O points can be obtained, and if it becomes so, the correspondence data of ** point can be computed.

[0069] The more concrete operation of this process is shown in drawing 12 , most, by the inside nest, the correspondence data D of the four lattice points set to i=1-4 (Ri, Gj, Bk) are used, and correspondence data [in the component value Rp in R shaft orientations] f (j) and (the correspondence data of - point) are computed. If four f (j) is obtained as j=1-4, within the nest on one, correspondence data [in the component value Bp in B shaft orientations] g (k) and (the correspondence data of O point) will be computed using this. And if four g (k) is obtained as k=1-4, within the top nest, h (correspondence data of ** point) is computable using this.

[0070] If it returns to the flow chart shown in drawing 10 , specification of an affiliation grid group will be performed at Step S310. if the four lattice points are fixed to each shaft orientations and an operation is performed as shown in drawing 11 and drawing 12 , since it is easy, the routine of an operation can be performed using the coordinate value of this cube -- it has sub-routine-ized Therefore, before performing the operation which interpolates the lattice point, the cube which becomes each shaft orientations which contain the lattice point concerned from the four lattice points is specified. And at Step S320, the correspondence data in the lattice point of this cube are moved to this work area.

[0071] In a work area, since the relation shown in drawing 11 is specified, at continuing Step S330, a nonlinear operation is performed by the nest processing shown in drawing 12 . In addition, since the offset to each shaft orientations arises in case it is made to move to a work area, it calculates by the coordinate value (Rp, Gp, Bp) which saved the amount of offset when making it move, and took the amount of the said offset into consideration to the coordinate value also about the increasing lattice point. In addition, although it has been processing of three steps of nests in drawing 12 corresponding to interpolation by three dimensions, it is also possible to carry out nest processing further corresponding to the interpolation in high order origin.

[0072] Thus, by giving the nonlinear operation by the lattice points other than the lattice point of former color translation table 21b2c, when loop processing of each shaft is ended, perfect color translation table 21b2b can be obtained.

[0073] In the operation gestalt mentioned above, although Lagrange's interpolation formula is used as concrete processing of a nonlinear operation, it is also possible to use other operations, for example, spline (spline) interpolation is also possible. Spline interpolation is the harder interpolation which it had when use which has a continuity to a derivative was completed and the continuity of a derivative became a problem in this meaning. However, calculation does not obtain an oak colander as it is complicated, but the coding list in which the concrete real whereabouts method of this spline interpolation operation was shown by C is shown in drawing 13 .

[0074] Moreover, as other nonlinear interpolation operations, it can be the Nevil (Neville) interpolation or the Newton (Newton) interpolation etc. can be used. Also numerically in these cases, calculation becomes easy.

[0075] On the other hand, about the lattice point mentioned above, the lattice spacing is set constant. Correspondence data can be moved by making a specific cube into a work area by this, and an operation can be intelligibly performed now. However, not necessarily, a lattice spacing must not necessarily be fixed and performing using the coefficient which considered the lattice spacing etc. is also possible.

[0076] Furthermore, in the operation gestalt mentioned above, although the nonlinear interpolation shown in drawing 10 - drawing 12 by interpolation data processing of Step S220 is used, it is also possible to use linear interpolation, as shown in

drawing 14 - drawing 19 .
[0077] While with a circle [white] shows the lattice point position before increasing the lattice point to drawing 14 , the black dot shows the lattice point position after increasing the lattice point, and since an operation is simple, the new lattice point has been prepared in the position which makes a lattice spacing a half. the original grid number shown in drawing is therefore, like parenthesis writing -- it becomes the grid number of two times exactly In addition, the number of the original lattice points is temporarily explained as "i." Moreover, drawing 15 shows the procedure of CPU of performing processing of linear interpolation, with the flow chart, drawing 16 shows the situation of movement of the first correspondence data, drawing 17 shows the lattice point interpolated, and drawing 18 shows the situation of a interpolation operation.
[0078] When the lattice point which makes between the lattice points a half shall be formed in each shaft, the grid coordinate of the lattice point before interpolation becomes (0, 2, 4, 6, and 8 --) at an automatic target, as shown in parenthesis writing of drawing 14 , and the meantime will be interpolated. If it returns to the flow chart shown in drawing 15 , CPU will first perform processing which shifts the lattice point data which are already in a table at Step S410 to the predetermined position of a new table. As shown in drawing 16 , for example, the correspondence data of a grid coordinate (0, 0, 0) as correspondence data of the grid coordinate (0, 0, 0) of a new table As correspondence data of the grid coordinate (0, 0, 2) of a table with the new correspondence data of a grid coordinate (0, 0, 1), as the correspondence data of a grid coordinate (0, 0, 2) are referred to as being as correspondence data of the grid coordinate (0, 0, 4) of a new table, they shift.
[0079] When interpolating the lattice point by linear interpolation, an operation changes with positions of the grid legislation inside of the body which consists of the eight surrounding lattice points. That is, in the case of the lattice point which exists on the side, it interpolates from the lattice point of two points of both sides, and although it interpolates from the four surrounding lattice points in the case of the lattice point which exists on a field and it exists in a center, a case is interpolated from the eight lattice points.
[0080] As sequence which increases the lattice point, processing which generates the lattice point on the grid side is first performed at Step S420. In data processing of CPU, in order to process by the loop which gave and carried out the nest of the parameter for every shaft, the block is displayed in the shape of a nest all over drawing.
[0081] Each shaft is given with "0", "2", "4", "6", and "8" --, and, speaking of R shaft orientations, a parameter generates the correspondence data of a grid coordinate (1, 0, 0) for it from a grid coordinate (0, 0, 0) and the data of (2, 0, 0). That is, as shown in drawing 18 , the correspondence data X1 of a grid coordinate (0, 0, 0) and the correspondence data X2 of a grid coordinate (2, 0, 0) are added, and it becomes the thing X4 which divided X3 by "2" as a result. In here, the division of "2" corresponds to a 1-bit right shift in binary number data, and can be performed very easily. Of course, since the 1-bit right shift is performed first, it may add, and overflow in operation process can be prevented in this case. Hereafter, the lattice point on the grid side is generated from a total combination of this parameter.
[0082] At Step S430, processing which generates the lattice point on a lattice plane is performed. In order to process by the loop which carried out the nest also in this case, as a parameter of each shaft "0", It gives with "2", "4", "6", and "8", and, speaking of a field parallel to RG side, the correspondence data of a grid coordinate (1, 1, 0) are generated from the data of a grid coordinate (0, 0, 0), (0, 2, 0), (2, 0, 0), and (2, 2, 0). In this case, what is necessary is to take the average of the four lattice points, and just to divide by "4", after adding four data. In addition, the division of "4" corresponds to a 2-bit right shift in binary number data, and can be performed very easily, and the lattice point on a lattice plane is hereafter generated from a total combination of this parameter.
[0083] Finally, at Step S440, processing which generates the lattice point of the central point is performed. In this case, it gives with "1", "3", "5", and "7" -- as a parameter of each shaft. The correspondence data of a grid coordinate (1, 1, 1) are generated from the correspondence data of eight grid coordinates (0, 0, 0) of a periphery, (0, 0, 2), (0, 2, 0), (0, 2, 2), (2, 0, 0), (2, 0, 2), (2, 2, 0), and (2, 2, 2). In this case, what is necessary is to take the average of the eight lattice points, and just to add, after performing the right shift of a triplet so that it may not overflow. Hereafter, the lattice point of all the central point is generated from a total combination of this parameter.
[0084] Interpolation of the lattice point is completed by performing the above processing. What is necessary is to be able to fluctuate suitably not only this example but if needed, to be in the tolerance of storage resources and just to make the lattice point increase, although the lattice point is made to increase so that a lattice spacing may be made into a half in this operation gestalt.
[0085] Moreover, the operation is easy though a lattice spacing is changed in order to pass over the foundations of an operation only to the correspondence data of two points of both sides, though a lattice spacing is suitably changed in linear interpolation also by the linear interpolation operation mentioned above, although the lattice spacing of the lattice point is fixed. therefore, the thing for which the change curve of correspondence data makes a lattice spacing fine in a large portion -- an operation -- interpolation precision can be raised while it has been easy
[0086] It is possible for it not to be necessary to necessarily set constant the lattice point to which it is made to increase also in linear interpolation also in nonlinear interpolation on the other hand, and to also make it change if needed.
[0087] As an example of the processing to which the lattice point is made to increase, the increase processing in the system correspondence lattice point which carries out table generation according to the configuration of a system is shown in the flow chart of drawing 19 .
[0088] In this example, the kind of CPU which expresses arithmetic proficiency with Step S510 is inputted, the clock which expresses operation speed with Step S520 similarly is inputted, memory space which influences arithmetic proficiency and operation speed at Step S530 is inputted, and the remaining capacity of the hard disk of a generation place is inputted at Step

S540.

[0089] And with reference to the system correspondence table beforehand set up corresponding to such combination, the number of the most suitable lattice points is read at Step S550. If the number of the lattice points can be obtained, increase processing in the lattice point will be performed at Step S560. What is necessary is for the interval of a grid to become large if the number of the lattice points memorized by this system correspondence table has arithmetic proficiency and quick operation speed as a general inclination, and just to set up, as it said that the interval of a grid became small, if there is much remaining capacity of a hard disk. Of course, the input element of configuration is not restricted to these and the gravity is not fixed, either. For example, when there is much remaining capacity of a hard disk, it is not impossible balance with a cache or to create the full-sized table of a certain thing, either.

[0090] In this case, you may make it ask whether the data of bit map systems, such as a photograph, have many objects printed as a user's operating environment, or there is much data of a draw data system between Step S540 and Step S550. And what is necessary is just to enlarge the number of the lattice points supposing the environment where weight will be placed by color-reproduction nature, such as a photograph, if there is much data of a bit map system, and if there is much data of a draw data system, color-reproduction nature, such as a business graph, should just make the number of the lattice points small supposing the environment which is not not much important.

[0091] Although increase processing of the lattice point is performed until now at the time of installation and it is made to generate color translation table 21b2b, you may make it generate color translation table 21b2b of size required at the time of printing in the storage section in which rapid access, such as RAM of a computer 21, is possible. Usually, small former color translation table 21b2c is stored in the hard disk at the time, and the merit which makes color translation table 21b2b of size required at the time of printing execution on RAM in which rapid access is possible is very large. Of course, what is necessary is just to decide the size which sets up the interval of a grid and is developed like [this place proposal] the case of a hard disk, taking the remaining capacity in which use by RAM is possible, the amount of the image data to output, the output quality desired into consideration.

[0092] Although printer driver 21b is started through operating system 21a when application 21d prints as shown in drawing 3 , a file type is passed to printer driver 21b at this time. In printer driver 21b, it judges whether it is a bit map system and whether it is a draw data system from the file types at this time (for example, bmp etc.), the number of the lattice points corresponding to it is set up, and color translation table 21b2b is generated. What is necessary is just to set up about the size of the number of these lattice points with the same inclination as the case where it is based on the installer mentioned above. Of course, it may judge by whether there to be as a method of distinguishing the kind of input data, or much color number of input data only with such an actual file type is few, and an operating system distinguishes the kind of object and you may make it notify to a printer driver.

[0093] Thus, if an installer is performed by computer 21 which constitutes an image processing system 20, although former color translation table 21b2c to color translation table 21b2b will be generated at Step S130 In the increase processing in the lattice point at this time, make the lattice point increase by the nonlinear interpolation operation using Lagrange's interpolation formula in Step S430, or You may be the number of the lattice points which carried out making the lattice point increase by linear interpolation etc., and were fixed on that occasion, it is good also as the number of the lattice points according to environment or the input picture, and color translation table 21b2b of suitable size can be generated from former color translation table 21b2c of small size.

[Translation done.]

DESCRIPTION OF DRAWINGS

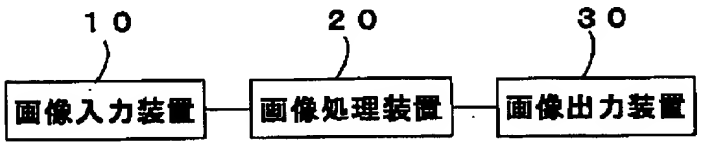
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the image processing system which applied the manufacturing installation of the color translation table concerning 1 operation gestalt of this invention.
[Drawing 2] It is the block diagram of the example of concrete hardware composition of this image processing system.
[Drawing 3] It is the block diagram showing the software configuration of a computer.
[Drawing 4] It is drawing showing the concept of a three-dimensions look-up table.
[Drawing 5] It is the flow chart of an install program.
[Drawing 6] It is drawing which carried out coding of the Lagrange's interpolation operation by C.
[Drawing 7] It is drawing showing the grid coordinate of a former color translation table.
[Drawing 8] It is drawing showing the file organization of a former color translation table and a color translation table.
[Drawing 9] It is the flow chart of the increase processing program in the lattice point.
[Drawing 10] It is the flow chart of a nonlinear interpolation program.
[Drawing 11] It is the conceptual diagram showing the procedure in the case of carrying out nonlinear interpolation by Lagrange's interpolation formula.
[Drawing 12] It is a flow chart corresponding to the Lagrange interpolation operation.
[Drawing 13] It is drawing which carried out coding of the spline interpolation operation by C.
[Drawing 14] It is explanatory drawing showing a grid coordinate before and after increasing the lattice point.
[Drawing 15] It is the flow chart of the increase processing program in the lattice point of linear interpolation.
[Drawing 16] It is drawing showing the file organization of a former color translation table and a color translation table.
[Drawing 17] It is outline explanatory drawing showing the position of the lattice point interpolated.
[Drawing 18] It is explanatory drawing showing the state of the operation which used the bit shift together.
[Drawing 19] It is the flow chart of the increase processing program in the system correspondence lattice point.
[Description of Notations]
20 -- Image processing system
21 -- Computer
21a -- Operating system
21b -- Printer driver
21b1 -- Rasterizer
21b2 -- Color transducer
21b2a -- Software for color conversion
21b2b -- Color translation table
21b2c -- Former color translation table
21b3 -- Gradation transducer
21c -- Video driver
21d -- Application
22 -- Hard disk
23 -- Drive equipment
24 -- CD-ROM

[Translation done.]

* NOTICES *

DRAWINGS

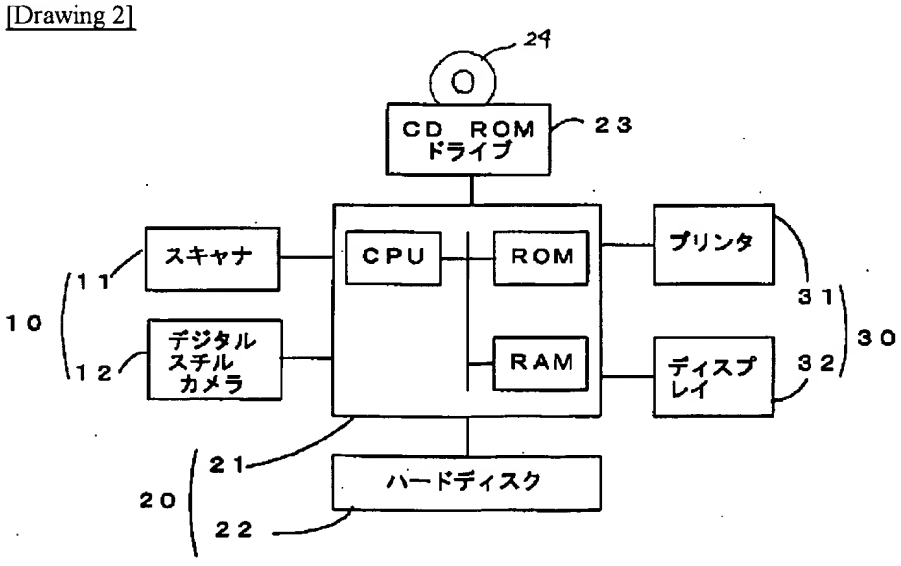
[Drawing 1]



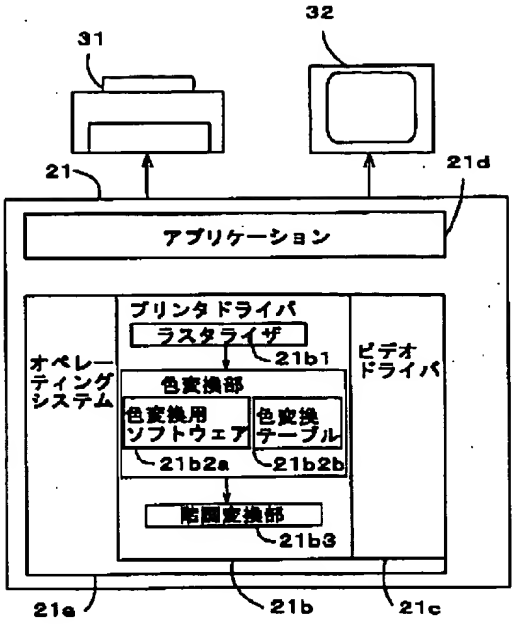
[Drawing 4]

Cx (Rx, Gx, Bx)
Mx (Rx, Gx, Bx)
Yx (Rx, Gx, Bx)

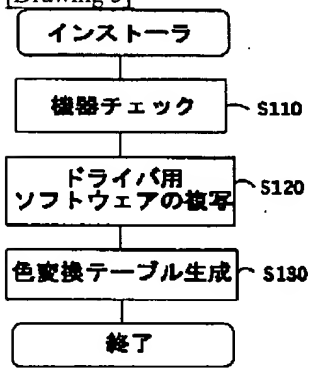
[Drawing 2]



[Drawing 3]



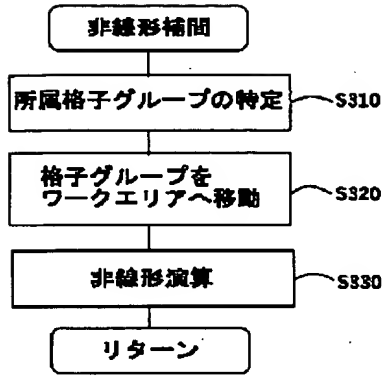
[Drawing 5]



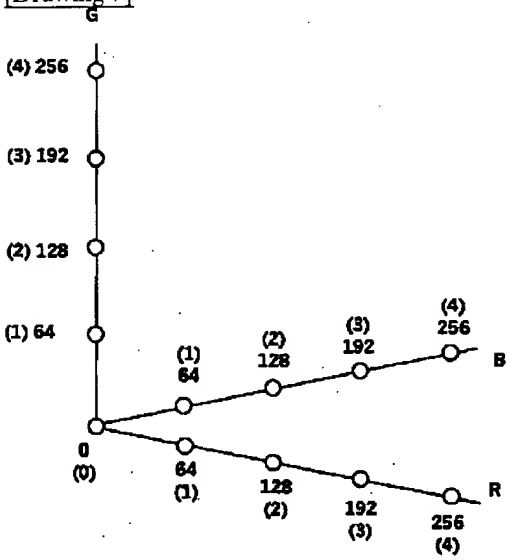
[Drawing 6]

```
 1 double lagrange(double t)
 2 {
 3       int i,j;
 4       double sum,prod;
 5
 6       sum=0;
 7       for (i=0;i<N;i++) {
 8             prod=y[i];
 9             for (j=0;j<N;j++)
10                   if (j!=i) prod ＊ =(t-x[j])/(x[i]-x[j]);
11             sum +=prod;
12       }
13       return sum;
14 }
```

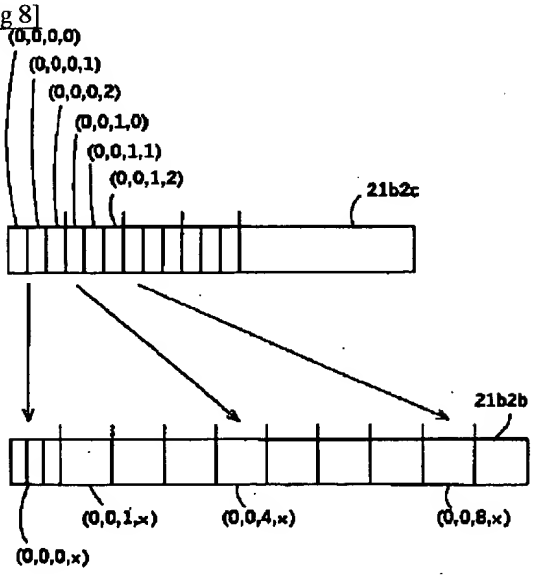
[Drawing 10]



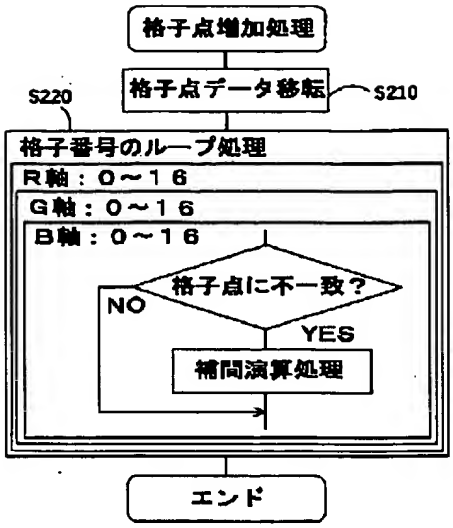
[Drawing 7]



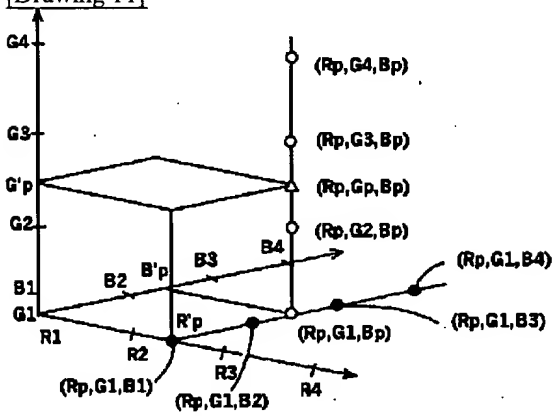
[Drawing 8]



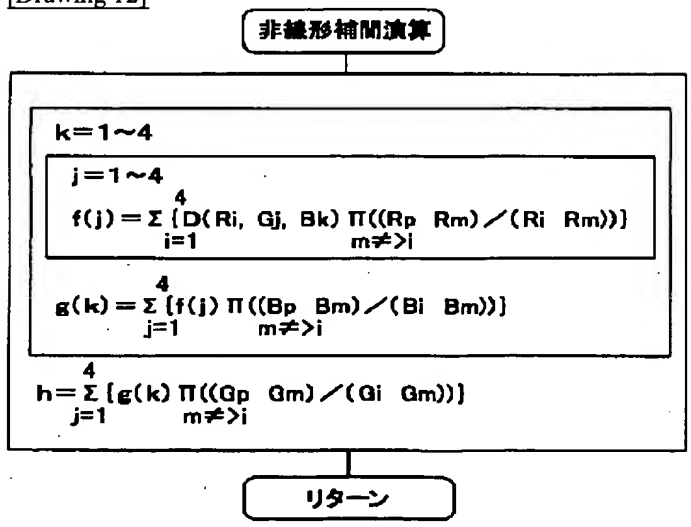
[Drawing 9]



[Drawing 11]



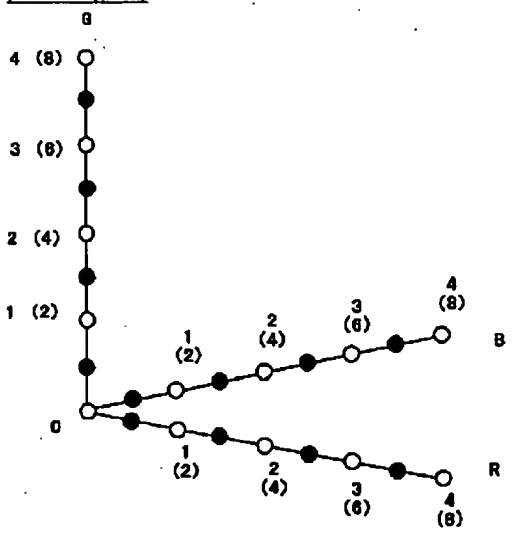
[Drawing 12]



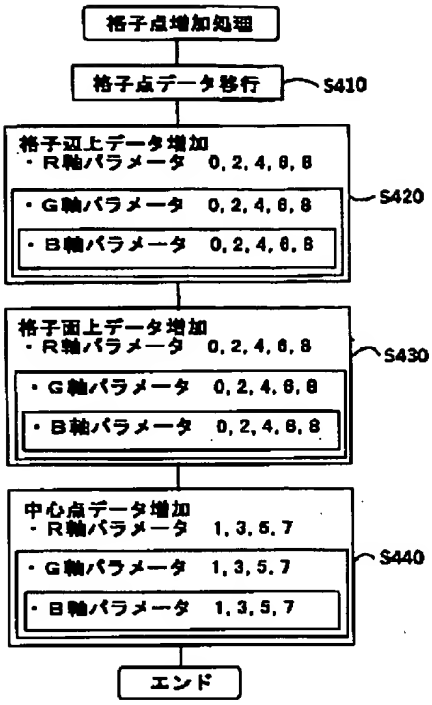
[Drawing 13]

```
1 void maketable(double x[  ], double y[  ], double z[  ])
2 {
3       int i;
4       double t;
5       static double h[N], d[N];
6
7       z[0]=0; z[N-1]=0;          /*  両端点でのy N(x)/8  */
8       for (i=0; i < N-1; i++)  {
9               h[i    ]=x[i+1]-x[i];
10              d[i+1]=(y[i+1]-y[i])/h[i];
11      }
12      z[1]=d[2]-d[1]-h[0] * z[0];
13      d[1]=2 * (x[2]-x[0]);
14      for(i=1; i < N-2;i++)  {
15              t=h[i]/d[i];
16              z[i+1]=d[i+2]-d[i+1]-z[i] * t;
17              d[i+1]=2 * (x[i+2]-x[i])-h[i] * t;
18      }
19      z[N-2]=h[N-2] * z[N-1];
20      for(i=N-2;i > 0;i--)
21      z[i]=(z[i]-h[i] * z[i+1])/d[i];
22 }
23
24 double spline(double t, double x[  ], double y[  ], double z[
25 {
26      int i, j, k;
27      double d, h;
28
29      i=0; j=N-1;
30      while (i < j)  {
31              k=(i+j)/2;
32              if(x[k] < t)  i=k+1;   else j=k;
33      }
34      if(i > 0) i--;
35      h=x[i+1]-x[i]; d=t-x[i];
36      return ((z[i+1]-z[i]) * d/h+z[i] * 3) * d
37              +((y[i+1]-y[i])/h
38              -(z[i] * 2 * z[i+1] * h)) * d+y[i];
39 }
```

[Drawing 14]

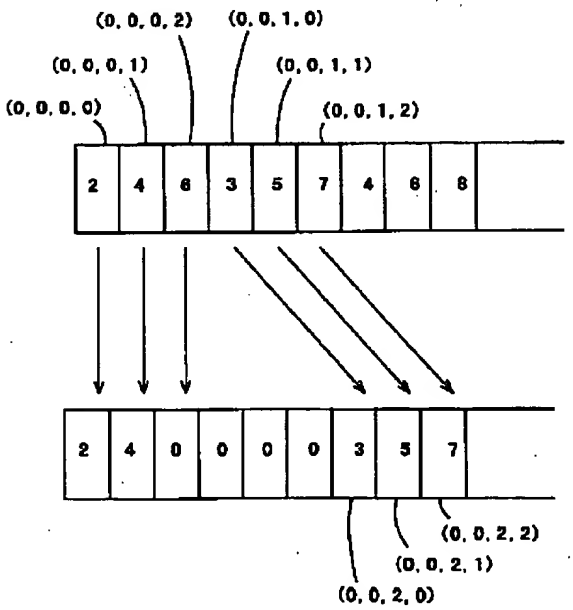


[Drawing 15]

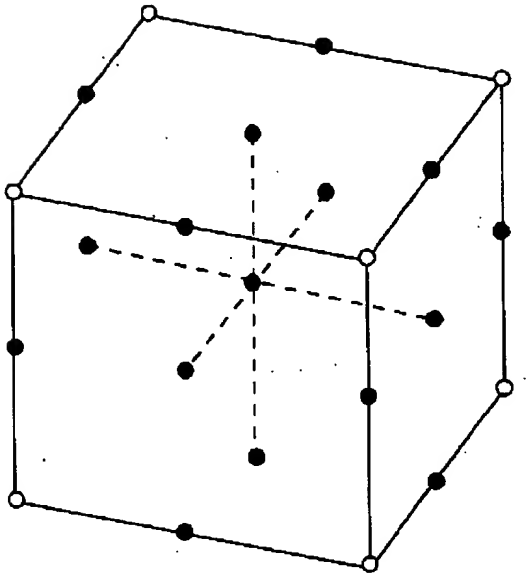


[Drawing 16]

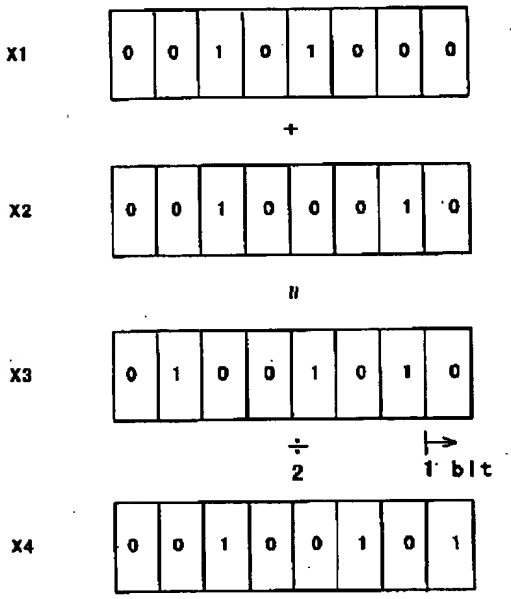
(R, G, B, C=0, M=1, Y=2)



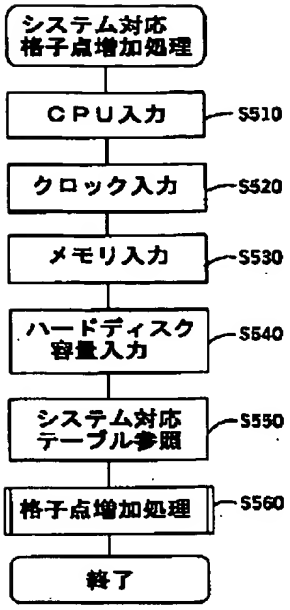
[Drawing 17]



[Drawing 18]



[Drawing 19]



[Translation done.]